

Center for Gas Separations Relevant to Clean Energy Technologies (CGS)

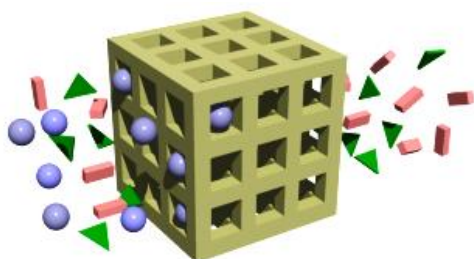
EFRC Director: Jeffrey R. Long

Lead Institution: University of California, Berkeley

Start Date: August 2009

Mission Statement: *To develop new materials and membranes that enable energy-efficient separation of gas mixtures, as required in the clean use of fossil fuels and in reducing emissions from industry. Particular emphasis is placed on separations that reduce CO₂ emissions from power plants and energy-intensive gas separations in industry and agriculture.*

Separation processes are estimated to be responsible for 10-15% of our total energy consumption. Given the expected increase in global population and the possibility of large-scale carbon capture and sequestration, this percentage is anticipated to increase significantly. Reducing the total energy costs of



separations would be a major contribution towards lowering our overall energy usage. The aim of the Center for Gas Separations (CGS) is to develop new strategies and materials that enable energy-efficient gas separations, based on molecule-specific chemical interactions, together with a fundamental understanding of the properties and performance of the materials.

The challenge is to remove the fundamental scientific barriers that currently prohibit the efficient separation of gases essential to the development of clean energy technologies. In gas separations these challenges are significant. The differences between the relevant gas molecules are small and therefore we need to use the type of molecular control that is offered by nanoscience and synthetic chemistry to tailor materials that have exactly the right adsorption and diffusion selectivity to enable an economic separation process.

The center brings together personnel with expertise in the following areas of emphasis:

- **Materials Synthesis:** The synthesis of new gas-permeable materials with control over the molecular functionalities to preferentially adsorb gas molecules is essential. Our focus here will be on:
(i) generating novel metal-organic frameworks exhibiting molecule-specific chemical interactions and
(ii) new membrane constructs incorporating these materials.
- **Materials Characterization:** Detailed atomic-level structural characterization of the new materials will be necessary both before and after exposure to gas samples in order to probe hypotheses on interaction mechanisms. In addition, accurate means of assessing the selectivity, kinetics, and thermodynamics of gas adsorbate binding will be needed to demonstrate efficacy and test computational models.
- **Computational Separations:** A strong computational component to the research will be essential for understanding the chemical interactions at a molecular level, as well as for guiding the synthetic efforts toward materials exhibiting high specificity and tunable interaction energies.

We aim to develop fundamental new means of synthesizing materials with tailored molecular interactions, while generating new options for energy-related gas separations, including the separation of CO₂ from power plant flue streams, the separation of CO₂ from natural gas deposits, the separation of oxygen from air, and the separation of various industrially relevant hydrocarbon mixtures.

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